(19)

(11) Publication number: 2003017325 A

PATENT ABSTRACTS OF JAPAN

(21) Application number: **2001195490**

(51) Intl. Cl.: **H01F 17/00** H01F 41/04

(22) Application date: **27.06.01**

(30) Priority:

(43) Date of application publication: **17.01.03**

(84) Designated contracting states:

(71) Applicant: **MURATA MFG CO LTD**

(72) Inventor: **SAKATA KEIJI**

(74) Representative:

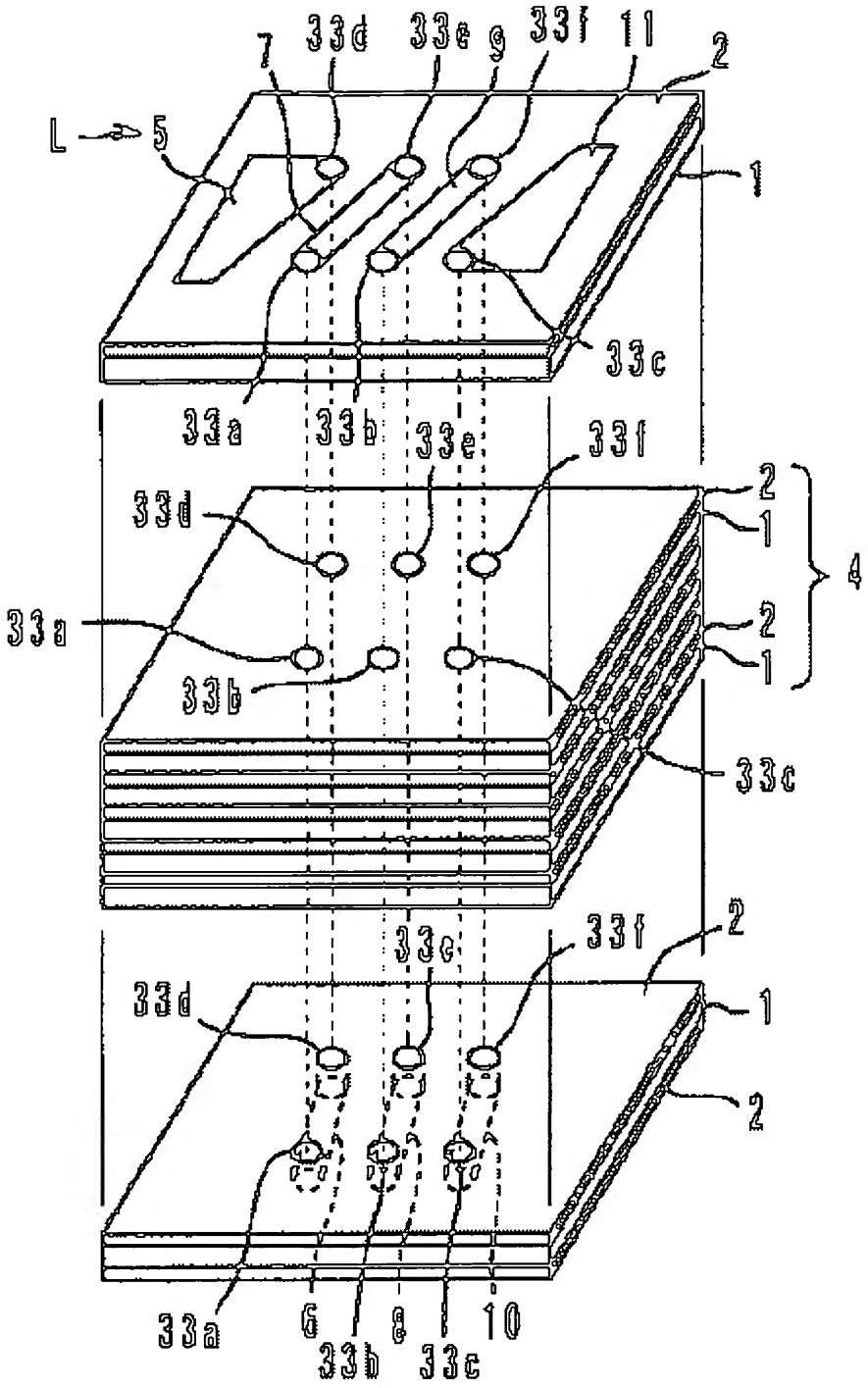
(54) LAMINATION TYPE METAL MAGNETIC ELECTRONIC COMPONENT AND ITS MANUFACTURING METHOD

(57) Abstract:

PROBLEM TO BE SOLVED: To provide a low-cost and compact lamination type metal magnetic electronic component using metal magnetic materials, and a method for manufacturing the lamination type metal magnetic electronic component.

SOLUTION: A thin plate 1 using a metal magnetic material as a main constituent is prepared, and a resin layer 2 is formed on the surface of the thin plate 1. The plurality of metal magnetic thin plates 1 are piled up, and bonded by the resin layer 2 for composing a laminate. Each of conductor patterns 5, 7, 9, and 11 for coils is electrically connected to conductor patterns 6, 8, 10 for coils in

series via via holes 33d, 33a, 33e, 33b, 33f, and 33c successively, and a spiral coil L is composed. The axis direction of the spiral coil L is vertical to the pile-up direction of the metal magnetic thin plate 1.



(19)日本国特許庁(JP)　(12)公開特許公報（A）　(11)特許出願公開番号

特開２００３－１７３２５

（Ｐ２００３－１７３２５Ａ）

(43)公開日　平成15年1月17日(2003.1.17)

(51)Int.Cl.⁷	識別記号	FI		テーマコード(参考)
Ｈ０１Ｆ　17/00		Ｈ０１Ｆ　17/00	Ｃ	5E062
41/04		41/04	Ｃ	5E070

審査請求　未請求　請求項の数６　ＯＬ　（全７頁）

(21)出願番号　特願2001-195490(P2001-195490)

(22)出願日　平成13年6月27日(2001.6.27)

(71)出願人　000006231
株式会社村田製作所
京都府長岡京市天神二丁目26番10号

(72)発明者　坂田　啓二
京都府長岡京市天神二丁目26番10号　株式会社村田製作所内

(74)代理人　100091432
弁理士　森下　武一

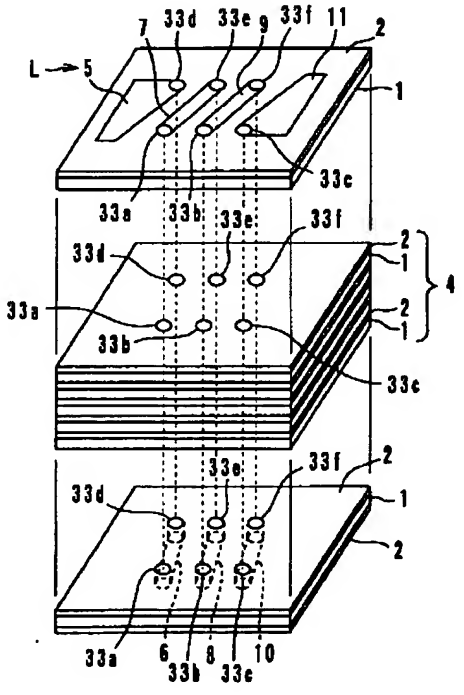
Ｆターム(参考)　5E062 DD04 FG11
5E070 AA01 AA11 CB03 CB13

(54)【発明の名称】積層型金属磁性電子部品及びその製造方法

(57)【要約】

【課題】　金属磁性材料を使った、低コストで小型の積層型金属磁性電子部品及びその製造方法を提供する。

【解決手段】　金属磁性材料を主成分とする薄板１を準備し、その表面に樹脂層２を形成する。複数の金属磁性薄板１は積み重ねられ、樹脂層２にて接着されて積層体を構成する。コイル用導体パターン５，７，９，１１はそれぞれ、ビアホール３３ｄ，３３ａ，３３ｅ，３３ｂ，３３ｆ，３３ｃを介して順次コイル用導体パターン６，８，１０に電気的に直列に接続され、螺旋状コイルＬを構成する。螺旋状コイルＬは、その軸方向が金属磁性薄板１の積み重ね方向に対して垂直である。



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【特許請求の範囲】

【請求項１】　複数の金属磁性板と、
前記複数の金属磁性板のそれぞれの表面に形成された樹脂層と、
前記複数の金属磁性板の表面に前記樹脂層を介して設けられた複数のコイル用導体パターンと、
前記複数のコイル用導体パターンを電気的に接続するために、前記金属磁性板に設けられたビアホール用孔に導電材を充填してなるビアホールとを備え、
前記複数の金属磁性板を積み重ねて前記樹脂層にて接着して構成した積層体に、前記複数のコイル用導体パターンを前記ビアホールを介して電気的に直列に接続して構成したコイルが設けられ、かつ、前記ビアホール用孔の内壁面が絶縁膜で覆われていること、
を特徴とする積層型金属磁性電子部品。

【請求項２】　前記コイルの軸方向が前記金属磁性板の積み重ね方向に対して直交していることを特徴とする請求項１に記載の積層型金属磁性電子部品。

【請求項３】　前記積層体の上面及び下面の少なくともいずれか一方の面に前記コイルの端末部が導出されるとともに、前記積層体の端面に設けた外部端子電極が、前記コイルの端末部に電気的に接続するように前記積層体の上面又は／及び下面に延在していることを特徴とする請求項１又は請求項２に記載の積層型金属磁性電子部品。

【請求項４】　金属磁性板の表面に樹脂層を形成する工程と、
前記金属磁性板にビアホール用孔を形成するとともに、
前記ビアホール用孔の内壁面を絶縁膜で覆う工程と、
前記ビアホール用孔に導電材を充填してビアホールを形成する工程と、
前記金属磁性板の表面に前記樹脂層を介してコイル用導体パターンを形成する工程と、
前記金属磁性板を積み重ね、前記樹脂層にて接着して積層体を形成するとともに、前記コイル用導体パターンを前記ビアホールを介して電気的に直列に接続してコイルを構成する工程と、
を備えたことを特徴とする積層型金属磁性電子部品の製造方法。

【請求項５】　金属磁性板の表面に樹脂層を形成する工程と、
前記金属磁性板にビアホール用孔を形成するとともに、
前記ビアホール用孔の内壁面を絶縁膜で覆う工程と、
前記金属磁性板を積み重ね、前記樹脂層にて接着してコンポジット体を形成するとともに、前記ビアホール用孔を積み重ね方向に連接する工程と、
前記連接されたビアホール用孔に導電材を充填して長尺状ビアホールを形成する工程と、
前記コンポジット体の上下に、樹脂層を介してコイル用導体パターンを表面に形成した金属磁性板を配置するとともに、該金属磁性板に形成したビアホールを介して前記コイル用導体パターンを前記長尺状ビアホールに電気的に接続してコイルを構成する工程と、
を備えたことを特徴とする積層型金属磁性電子部品の製造方法。

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【請求項６】　全ての工程における加工が３００℃以下の温度条件で行われることを特徴とする請求項３又は請求項４に記載の積層型金属磁性電子部品の製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、積層型金属磁性電子部品及びその製造方法に関する。

【０００２】

【従来の技術】従来より、大電流が流れる電源回路やＤＣ／ＤＣコンバータ回路用のインダクタやトランスなどとして使用される積層型金属磁性電子部品が知られている。そして、例えば、積層型インダクタは、磁性体材料（フェライト）や絶縁体材料からなるセラミックスグリーンシートを複数枚積み重ね、一体的に焼成して積層体を構成している。この積層体の内部には、複数のコイル用導体パターンをビアホールを介して電気的に直列に接続して構成したコイルが設けられている。このように、従来の積層型インダクタは、絶縁性の高いセラミックスグリーンシートを使っているため、コイル用導体パターンやビアホールをセラミックスグリーンシートにそのまま形成することができ、加工が容易であるという利点がある。

【０００３】

【発明が解決しようとする課題】ところが、セラミックスを焼成させるには、９００℃程度の温度で処理する必要がある。従って、高温の焼成炉が必要となり、高いランニングコストも含めて、従来の積層型インダクタの製造コストをアップさせる一因となっていた。また、高温度の処理のため、積層型インダクタの内部残留応力も比較的大きかった。一方、セラミックスとフェライト等の酸化物磁性材料は磁気特性に問題があり、一般的なＮｉＺｎ系フェライトの透磁率は約２０００で、飽和磁束密度は約５０００ガウスしかない。従って、この酸化物磁性材料を用いた積層型インダクタは電気特性の限界が低く、小型化が困難であった。

【０００４】これに対して、金属磁性材料は磁気特性が優れており、特に飽和磁束密度が高いという特長を有している。しかしながら、金属磁性材料は比抵抗が小さく、コイル用導体パターンやビアホールを直接形成することができないため、従来、積層構造の電子部品には適用が困難であった。さらに、金属磁性材料は、セラミックス焼成時のような高温に晒すと酸化して特性が低下するため、半田付け温度（約３００℃）の低温で加工するのが基本となっていた。従って、従来は、低温処理する巻線コイル用として使われていたに過ぎなかった。

【０００５】そこで、本発明の目的は、金属磁性材料を使った、低コストで小型の積層型金属磁性電子部品及びその製造方法を提供することある。

【０００６】

【課題を解決するための手段及び作用】前記目的を達成するため、本発明に係る積層型金属磁性電子部品は、

（ａ）複数の金属磁性板と、（ｂ）複数の金属磁性板のそれぞれの表面に形成された樹脂層と、（ｃ）複数の金属磁性板の表面に樹脂層を介して設けられた複数のコイル用導体パターンと、（ｄ）複数のコイル用導体パターンを電気的に接続するために、金属磁性板に設けられたビアホール用孔に導電材を充填してなるビアホールとを備え、（ｅ）複数の金属磁性板を積み重ねて樹脂層にて接着して構成した積層体に、複数のコイル用導体パターンをビアホールを介して電気的に直列に接続して構成したコイルが設けられ、かつ、ビアホール用孔の内壁面が絶縁膜で覆われていること、を特徴とする。

【０００７】ここに、コイルの軸方向は、金属磁性板の積み重ね方向に対して直交していることが好ましい。さらに、積層体の上面及び下面の少なくともいずれか一方の面にコイルの端末部が導出されるとともに、積層体の端面に設けた外部端子電極が、コイルの端末部に電気的に接続するように積層体の上面又は／及び下面に延在していることが好ましい。

【０００８】また、本発明に係る積層型金属磁性電子部品の製造方法は、（ｆ）金属磁性板の表面に樹脂層を形成する工程と、（ｇ）金属磁性板にビアホール用孔を形成するとともに、ビアホール用孔の内壁面を絶縁膜で覆う工程と、（ｈ）ビアホール用孔に導電材を充填してビアホールを形成する工程と、（ｉ）金属磁性板の表面に樹脂層を介してコイル用導体パターンを形成する工程と、（ｊ）金属磁性板を積み重ね、樹脂層にて接着して積層体を形成するとともに、コイル用導体パターンをビアホールを介して電気的に直列に接続してコイルを構成する工程と、を備えたことを特徴とする。

【０００９】あるいは、本発明に係る積層型金属磁性電子部品の製造方法は、（ｋ）金属磁性板の表面に樹脂層を形成する工程と、（ｌ）金属磁性板にビアホール用孔を形成するとともに、ビアホール用孔の内壁面を絶縁膜で覆う工程と、（ｍ）金属磁性板を積み重ね、樹脂層にて接着してコンポジット体を形成するとともに、ビアホール用孔を積み重ね方向に連接する工程と、（ｎ）連接されたビアホール用孔に導電材を充填して長尺状ビアホールを形成する工程と、（ｏ）コンポジット体の上下に、樹脂層を介してコイル用導体パターンを表面に形成した金属磁性板を配置するとともに、該金属磁性板に形成したビアホールを介してコイル用導体パターンを長尺状ビアホールに電気的に接続してコイルを構成する工程と、を備えたことを特徴とする。

【００１０】以上の構成により、積み重ねられた金属磁性板同士は樹脂層にて接着され、積層体とされる。コイル用導体パターンは、樹脂層によって金属磁性板と直接に接触しなくてすむ。ビアホールは、ビアホール用孔の内壁面を覆っている絶縁膜によって、金属磁性板と直接に接触しなくてすむ。

【００１１】そして、コイル用導体パターンやビアホール用孔に充填される導電材などに、３００℃以下の温度条件で加工できる熱硬化型導電ペーストや低温焼成できる導電ペーストを用い、全ての工程における加工を３００℃以下の温度条件で行うようにすることにより、金属磁性板の特性劣化を防ぐことができる。

【００１２】

【発明の実施の形態】以下、本発明に係る積層型金属磁性電子部品及びその製造方法の実施の形態について添付の図面を参照して説明する。

【００１３】［第１実施形態、図１～図１１］第１実施形態は、積層型インダクタを例にして説明する。図１に示すように、金属磁性材料を主成分とする薄板１を準備し、その表面に樹脂層２を形成する。金属磁性薄板１の厚みは、渦電流損を少なくするため、できるだけ薄いものが良く、本第１実施形態では厚さが約５０μｍの珪素鋼板を使用した。

【００１４】樹脂層２の材料としては、仮硬化できる熱硬化性樹脂（例えばエポキシ、ポリイミド）や、熱融着性のある熱可塑性樹脂（例えばポリフェニレンサルファイド、ポリエーテルエーテルケトン、ポリエチレンテレフタレート、ポリフェニレンオキサイト）などが使用される。樹脂層２を形成する方法としては、スクリーン印刷法、スプレー噴霧法、ディッピング法、ドクターブレード法、あるいは、樹脂シートを接着させる方法が使用される。本第１実施形態は、表面が平坦でかつ均一な厚みを有する樹脂層２を得ることができるように、スクリーン印刷法にて金属磁性薄板１の表面（あるいは表裏両面）に厚さが約２０μｍのエポキシ樹脂層２を形成し、適温にて仮硬化させた。

【００１５】次に、図２に示すように、金属磁性薄板１の所定位置にビアホール用孔３ａ～３ｆを形成する。本第１実施形態では、炭酸ガスレーザ加工を行い、レーザビームＬＢをスポット照射して金属磁性薄板１および樹脂層２を高温で分解、焼失させた。このとき、金属磁性薄板１のビアホール用孔３ａ～３ｆの内壁面には、高温によって酸化膜（絶縁膜）が形成される。なお、ビアホール用孔３ａ～３ｆは断面円形であるが、楕円形や矩形等であってもよい。

【００１６】次に、図３に示すように、ビアホール用孔３ａ～３ｆが形成された金属磁性薄板１を複数枚準備し、積み重ねる。このとき、樹脂層２を上にし、各金属磁性薄板１のビアホール用孔３ａ～３ｆが積み重ね方向に連接するようにする。この後、加熱しながら加圧して、一時的に溶融した樹脂層２にて金属磁性薄板１相互

を接着する。こうして、コンポジット体４が得られる。

【００１７】次に、コンポジット体４のビアホール用孔３ａ～３ｆに導電性ペーストを充填する。つまり、図４に示すように、上部に開口３０ａを有したキャビティ３０にコンポジット体４を載置する。コンポジット体４の上面には、ビアホール用孔３ａ～３ｆに対応した穴３１ａを形成したマスキング材３１が載せられる。この後、キャビティ３０内の空気を吸引しながら、導電性ペースト３２をスキージ３３で掃引きすることにより、導電性ペースト３２をビアホール用孔３ａ～３ｆに充填させる。導電性ペースト３２は、主成分の銀又は銅などの低抵抗導電材料に熱硬化性樹脂を加えた熱硬化型のものや、低温焼結型のものが使用される。充填された導電性ペースト３２は、乾燥状態、硬化状態又は焼結状態とされる。こうして、長尺状ビアホール３３ａ～３３ｆ（図５参照）が形成される。

【００１８】なお、本第１実施形態は、マスキング材３１を使用してコンポジット体４の上面に厚膜導体を形成している。しかし、厚膜導体を形成する必要がなければ、スクリーン版を使用したスクリーン印刷法であってもよい。また、導電性ペーストをビアホール用孔３ａ～３ｆに充填する方法として、導電性ペースト浴にコンポジット体４を浸漬して真空脱泡する方法もある。ただし、この方法は、導電性ペーストがビアホール用孔３ａ～３ｆ内だけでなく、コンポジット体４の表面にも付着するため、表面に付着した導電性ペーストを削り取る作業が必要になる。

【００１９】次に、図５に示すように、コンポジット体４の上に、コイル用導体パターン５，７，９，１１を上面に設けた金属磁性薄板１が配置される。この金属磁性薄板１は図２に示したものと同様のものであり、樹脂層２の表面にスクリーン印刷法等でコイル用導体パターン５，７，９，１１を形成するとともに、ビアホール用孔３ａ～３ｆに導電性ペーストを充填してビアホール３３ａ～３３ｆを形成している。

【００２０】また、コンポジット体４の下に、コイル用導体パターン６，８，１０を下面に設けた金属磁性薄板１が配置される。この金属磁性薄板１は、図２に示したものにおいて、上下両面に樹脂層２を形成したものと同様のものである。そして、下面に形成された樹脂層２の表面には、スクリーン印刷法等でコイル用導体パターン６，８，１０を形成するとともに、ビアホール用孔３ａ～３ｆに導電性ペーストを充填してビアホール３３ａ～３３ｆを形成している。ここで、コイル用導体パターン５～１１およびビアホール３３ａ～３３ｆの形成に使用される導電性ペーストは、樹脂層２が融解しない温度、すなわち、樹脂層２が接着機能を失わない程度の低い温度（３００℃以下）で処理できるものである。

【００２１】上段のコイル用導体パターン５，７，９，１１並びに下段のコイル用導体パターン６，８，１０はそれぞれ同一層に配置されている。コイル用導体パターン５，７，９，１１はそれぞれ、同一層に配置されているビアホール３３ｄ，３３ａ，３３ｅ，３３ｂ，３３ｆ，３３ｃを介して順次コイル導体パターン６，８，１０に電気的に直列に接続され、螺旋状コイルＬを構成する。螺旋状コイルＬは、その軸方向が金属磁性薄板１の積み重ね方向に対して垂直であり、かつ、後述の入出力外部電極２０，２１に対して垂直である。言い換えると、螺旋状コイルＬの軸方向は、積層型インダクタ２５の実装面に対して平行である。

【００２２】この後、コンポジット体４と上下に配置された金属磁性薄板１とを、加熱しながら加圧して樹脂層２にて一体的に接着し、図６に示すような矩形体状の積層体１２とされる。

【００２３】次に、マスキング材を使用して、積層体１２の上下面に高耐熱性の熱硬化型樹脂をマスク印刷し、適温にて熱硬化させて保護層１３，１４を形成する。保護層１３は、開口部１３ａ，１３ｂから露出しているコイル用導体パターン５，１１の一部を残して、コイル用導体パターン５，７，９，１１を被覆している。同様に、保護層１４はコイル用導体パターン６，８，１０を被覆している。

【００２４】また、積層体１２の側面には金属磁性薄板１の縁部が露出しているので、側面部を高耐熱性の熱硬化型樹脂浴に浸漬して、適温にて熱硬化させ、図７に示すように、絶縁被覆膜１５を形成する。なお、積層体１２を高温で加熱して、側面に露出している金属磁性薄板１の縁部の表面を酸化させ、酸化物被膜を形成させてもよい。

【００２５】次に、図８に示すように、積層体１２の左右両端部を、熱硬化型導電性ペースト浴又は低温焼結型導電性ペースト浴に浸漬して、適温にて硬化あるいは焼結させ、外部端子電極の下地電極を形成する。この下地電極の表面にめっきをして外部端子電極２０，２１を形成する。外部端子電極２０，２１は、それぞれ積層体１２の左右の端面に設けられ、螺旋状コイルＬの端末部（すなわち、コイル用導体パターン５，１１）に電気的に接続するように積層体１２の上面に延在している。こうして、積層型インダクタ２５が得られる。図９は積層型インダクタ２５の模式断面図である。

【００２６】以上の構成からなる積層型インダクタ２５は、金属磁性薄板１を使用して積層体１２を形成しているので、従来のセラミックスグリーンシートを使用して積層体を形成した場合と比較して、加工時の変形が起きにくく、加工精度の良い積層体１２が得られる。しかも、金属磁性材料はセラミックス材料と比較して機械的強度が高く、積層体１２の厚みが薄くても破損しにくい。

【００２７】また、金属磁性薄板１を樹脂層２を介して積層しているため、渦電流の発生を軽減することができ

る。さらに、螺旋状コイルＬによって生じる磁束は金属磁性薄板１内を主面に平行に通り、薄板１のコイル用導体パターン５～１１を被覆する保護層１３，１４は、非磁性材料の樹脂からなるため、この部分に渦電流は発生せず、より損失の少ない積層型インダクタ２５を得ることができる。図１０および図１１はそれぞれ、積層型インダクタ２５の周波数特性並びに直流重畳特性を示すグラフである（実線４０参照）。なお、図１０および図１１には、従来のフェライトからなるセラミックスグリーンシートを使用して製作した積層型インダクタの周波数特性並びに直流重畳特性も併せて記載している（点線４１参照）。積層型インダクタ２５は、従来のインダクタと比較して、インダクタンス値が高周波域で早く低下するが、直流重畳特性は優れている。さらに、珪素鋼の飽和磁束密度はフェライトの約４倍あり、従来のインダクタで問題となる内部残留応力も小さいため、優れた特性が得られる。

【００２８】さらに、コイル用導体パターン５～１１、ビアホール３３ａ～３３ｆ及び外部端子電極２０，２１の導電性材料や、樹脂層２の絶縁性材料として、低温（３００℃以下）で処理できる材料を用いているため、全ての処理工程を３００℃以下の温度条件の下で行うことができる。従って、金属磁性薄板１の特性劣化を防止できる。

【００２９】［第２実施形態、図１２］第２実施形態は、前記第１実施形態の積層型インダクタ２５をマザー基板を用いて量産する場合を例にして説明する。

【００３０】積層型インダクタ２５が複数個取れるような広面積の金属磁性マザー薄板１Ａを準備し、縦横にインダクタ２５の配列位置を決定する。この位置に合わせて、第１実施形態と同様の方法で、配列数分の樹脂層２Ａ並びにビアホール用孔３ａ～３ｆを形成し、さらに、ビアホール用孔３ａ～３ｆに導電性ペーストを充填してビアホール３３ａ～３３ｆを形成する。このとき、コイル用導体パターン５～１１も所定の金属磁性マザー薄板１Ａに形成される。

【００３１】次に、図１２に示すように、こうして加工されたビアホール３３ａ～３３ｆのみを設けた金属磁性マザー薄板１Ａを必要数積み重ね、その上下にコイル用導体パターン５～１１を形成した金属磁性マザー薄板１Ａを配置し、さらにその外側に保護用マザーシート１３Ａ，１４Ａを配置する。この後、全体を加熱しながら加圧して、金属磁性マザー基板１Ａを樹脂層２Ａにて一体的に接着し、マザー積層体を形成する。なお、図１２において、金属磁性マザー薄板１Ａに形成したコイル用導体パターン５～１１やビアホール３３ａ～３３ｆは省略している。

【００３２】次に、このマザー積層体をダイサーやレーザビーム、あるいはジェット水流で縦横に切断し、図１２の一点鎖線で囲んだサイズ毎に切り出し、積層体１２を得る。このとき、ダイサーやレーザビームでマザー積層体を切断した場合には、切断の際に生じる高熱で、積層体１２の切断面に露出した金属磁性薄板１Ａの縁部の表面が酸化して絶縁化する。従って、積層体１２の側面に絶縁処理をする必要がない。この後、第１実施形態と同様の方法で外部端子電極２０，２１を積層体１２の左右の端面に設け、完成品とする。

【００３３】このように、本第２実施形態は金属磁性マザー薄板１Ａを使用しているため、一度で大量に生産でき、低コストで能率良く積層型インダクタ２５を得ることができる。なお、セラミックスグリーンシートを使用して積層体を形成する場合にも、広面積のグリーンシートを用いれば取り個数が増え、量産に対応することができる。しかしながら、この場合、グリーンシートでは加工時の収縮や伸びが大きく、一層の加工精度向上が求められる。これに対して、金属磁性マザー薄板１Ａでは加工時の収縮や伸びが起きにくく、比較的容易に取り個数を増やすことができる。

【００３４】［他の実施形態］なお、本発明は前記実施形態に限定するものではなく、その要旨の範囲内で種々に変更することができる。例えば、本発明は、インダクタの他に、チョークコイルやトランス、あるいはコイルを含んだ複合電子部品にも適用することができる。さらに、金属磁性薄板１のビアホール用孔３ａ～３ｆの内壁面の絶縁化の方法としては、樹脂の電着塗装法などを採用してもよい。

【００３５】

【発明の効果】以上の説明から明らかなように、本発明によれば、金属磁性板を使用して積層体を形成しているので、従来のセラミックスグリーンシートを使用して積層体を形成した場合と比較して、加工時の変形が起きにくく、加工精度の良い積層体を得ることができる。しかも、金属磁性材料はセラミックス材料と比較して機械的強度が高く、積層体の厚みが薄くても破損しにくい。

【００３６】また、金属磁性板を樹脂層を介して積層しているため、渦電流の発生を軽減することができる。さらに、コイルの軸方向を金属磁性板の積み重ね方向に対して垂直にすることにより、コイルによって生じる磁束は金属磁性板内を主面に平行に通り、渦電流の発生をより一層抑えることができる。

【００３７】また、全ての工程における加工を３００℃以下の温度条件で行うことにより、金属磁性板の特性劣化を防止することができる。

【図面の簡単な説明】

【図１】本発明に係る積層型金属磁性電子部品の製造方法の一例を示す斜視図。

【図２】図１に続く製造工程を示す斜視図。

【図３】図２に続く製造工程を示す斜視図。

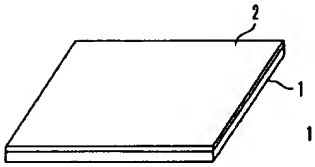
【図４】図３に続く製造工程を示す断面図。

【図５】図４に続く製造工程を示す斜視図。

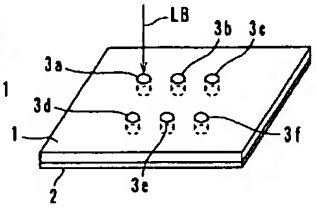
【図６】図５に続く製造工程を示す斜視図。
【図７】図６に続く製造工程を示す斜視図。
【図８】図７に続く製造工程を示す斜視図。
【図９】図８に示した積層型金属磁性電子部品の模式断面図。
【図１０】図８に示した積層型金属磁性電子部品の周波数特性を示すグラフ。
【図１１】図８に示した積層型金属磁性電子部品の直流重畳特性を示すグラフ。
【図１２】本発明に係る積層型金属磁性電子部品の製造方法の別の一例を示す分解斜視図。
【符号の説明】

１…金属磁性薄板
１Ａ…金属磁性マザー薄板
２，２Ａ…樹脂層
３ａ～３ｆ…ビアホール用孔
４…コンポジット体
５～１１…コイル用導体パターン
１２…積層体
２０，２１…外部端子電極
２５…積層型インダクタ
３２…導電性ペースト
３３ａ～３３ｆ…ビアホール
Ｌ…螺旋状コイル

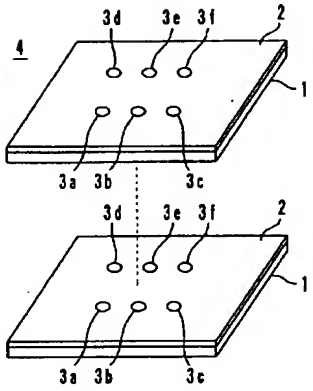
【図１】



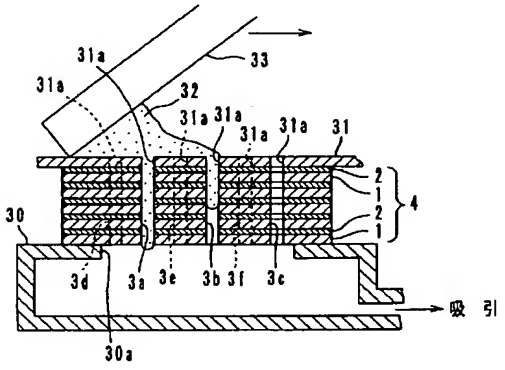
【図２】



【図３】



【図４】



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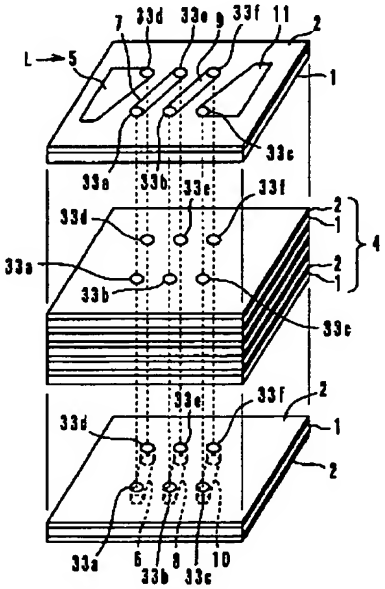

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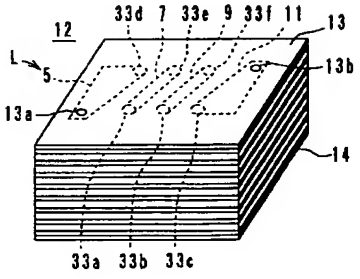

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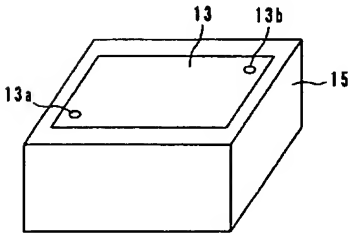

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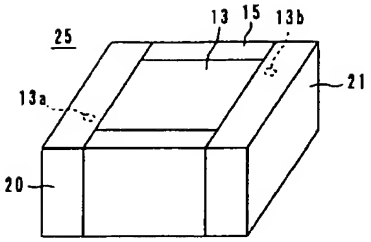

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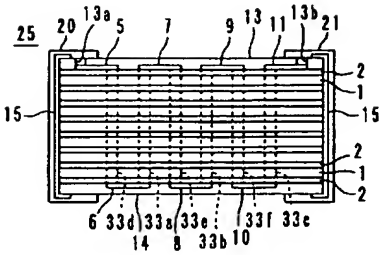
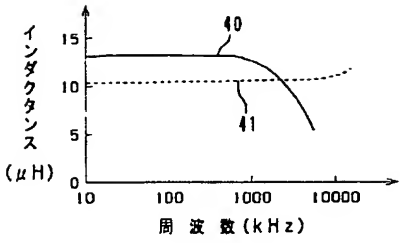
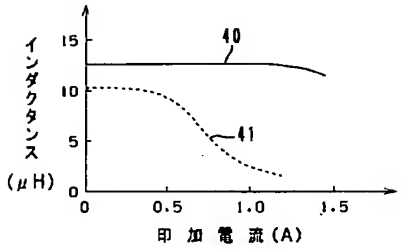


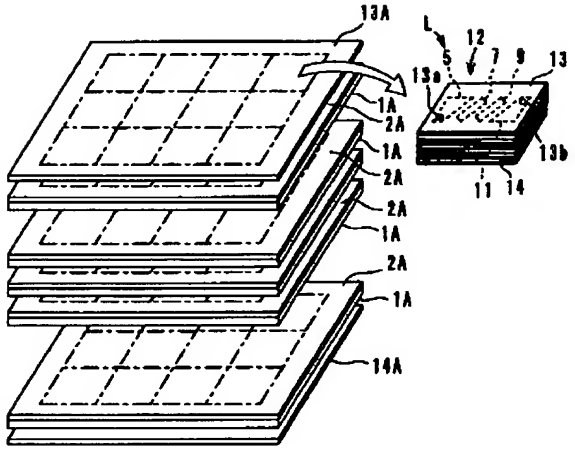
【図１０】



【図１１】



【図１２】



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(19) [Publication country] Japan Patent Office (JP)
(12) [Kind of official gazette] Open patent official report (A)
(11) [Publication No.] JP,2003-17325,A (P2003-17325A)
(43) [Date of Publication] January 17, Heisei 15 (2003. 1.17)
(54) [Title of the Invention] Laminating mold metal magnetism electronic parts and its manufacture approach
(51) [The 7th edition of International Patent Classification]
H01F 17/00
41/04
[FI]
H01F 17/00 C
41/04 C
[Request for Examination] Un-asking.
[The number of claims] 6
[Mode of Application] OL
[Number of Pages] 7
(21) [Application number] Application for patent 2001-195490 (P2001-195490)
(22) [Filing date] June 27, Heisei 13 (2001. 6.27)
(71) [Applicant]
[Identification Number] 000006231
[Name] Murata Manufacturing Co., Ltd.
[Address] 2-26-10, Tenjin, Nagaokakyo-shi, Kyoto
(72) [Inventor(s)]
[Name] Sakata Keiji
[Address] 2-26-10, Tenjin, Nagaokakyo-shi, Kyoto Inside of Murata Manufacturing Co., Ltd.
(74) [Attorney]
[Identification Number] 100091432
[Patent Attorney]

[Name] Morishita Takeichi
[Theme code (reference)]
5E062
5E070
[F term (reference)]
5E062 DD04 FG11
5E070 AA01 AA11 CB03 CB13

[Translation done.]

Epitome

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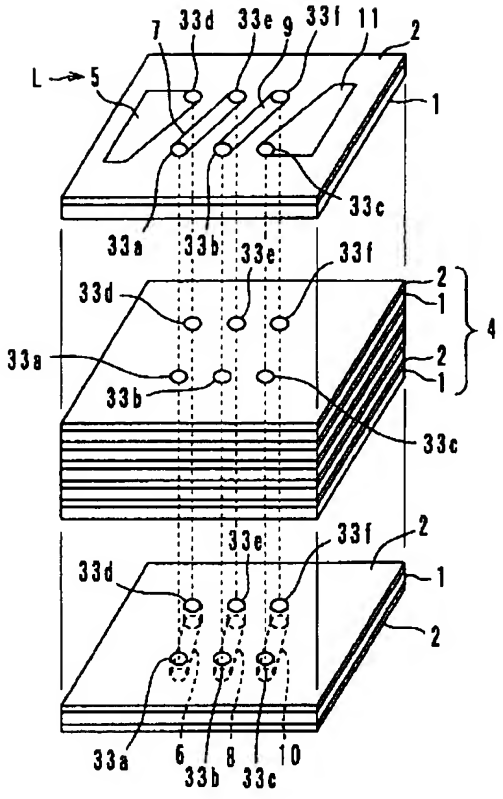
(57) [Abstract]
[Technical problem] Small laminating mold metal magnetism electronic parts and its manufacture approach are offered by the low cost using a metal magnetic material.
[Means for Solution] The sheet metal 1 which uses a metal magnetic material as a principal component is prepared, and the resin layer 2 is formed in the front face. It is put, it pastes up in the resin layer 2, and two or more metal magnetism sheet metal 1 constitutes a layered product. It connects with the conductor patterns 6, 8, and 10 for coils electrically one by one at a serial through beer halls 33d, 33a, 33e, 33b, 33f, and 33c, and the conductor patterns 5, 7, 9, and 11 for coils constitute the spiral coil L, respectively. The shaft orientations of the spiral coil L are vertical to the direction of a pile of metal magnetism sheet metal 1.

[Translation done.]



[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] Two or more metal magnetism plates and the resin layer formed in each front face of two or more of said metal magnetism plates, In order to connect electrically two or more conductor patterns for coils prepared in the front face of two or more of said metal magnetism plates through said resin layer, and said two or more conductor patterns for

coils It has the beer hall which comes to fill [electric conduction material] up the hole for beer halls prepared in said metal magnetism plate. To the layered product which accumulated said two or more metal magnetism plates, was pasted up and constituted from said resin layer Laminating mold metal magnetism electronic parts characterized by preparing the coil which connected and constituted electrically said two or more conductor patterns for coils in the serial through said beer hall, and covering the internal surface of said hole for beer halls by the insulator layer.

[Claim 2] Laminating mold metal magnetism electronic parts according to claim 1 characterized by the shaft orientations of said coil lying at right angles to the direction of a pile of said metal magnetism plate.

[Claim 3] Laminating mold metal magnetism electronic parts according to claim 1 or 2 characterized by having extended on the top face or/and underside of said layered product so that the external terminal electrode of the top face of said layered product and an underside prepared in the end face of said layered product while the terminal section of said coil was drawn by one of fields at least may connect with the terminal section of said coil electrically.

[Claim 4] The manufacture approach of the laminating mold metal magnetism electronic parts characterized by providing the following The process which forms a resin layer in the front face of a metal magnetism plate The process which covers the internal surface of said hole for beer halls by the insulator layer while forming the hole for beer halls in said metal magnetism plate The process which fills up said hole for beer halls with electric conduction material, and forms a beer hall The process which forms the conductor pattern for coils in the front face of said metal magnetism plate through said resin layer, and the process which connects said conductor pattern for coils to a serial electrically through said beer hall, and constitutes a coil while accumulating said metal magnetism plate, pasting up in said resin layer and forming a layered product

[Claim 5] The manufacture approach of the laminating mold metal magnetism electronic parts characterized by providing the following The process which forms a resin layer in the front face of a metal magnetism plate The process which covers the internal surface of said hole for beer halls by the insulator layer while forming the hole for beer halls in said metal magnetism plate The process which connects said hole for beer halls in the direction of a pile while accumulating said metal magnetism plate, pasting up in said resin layer and forming a composite object The process which fills up with electric conduction material said

hole for the beer halls it was connected [beer halls], and forms a long picture-like beer hall, and the process which connects said conductor pattern for coils to said long picture-like beer hall electrically through the beer hall formed in this metal magnetism plate, and constitutes a coil while arranging the metal magnetism plate of said composite object which formed the conductor pattern for coils in the front face through the resin layer up and down
[Claim 6] The manufacture approach of the laminating mold metal magnetism electronic parts according to claim 3 or 4 characterized by performing processing in all processes on temperature conditions 300 degrees C or less.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to laminating mold metal magnetism electronic parts and its manufacture approach.
[0002]
[Description of the Prior Art] The laminating mold metal magnetism electronic parts conventionally used as an inductor, a transformer, etc. the power circuit where a high current flows, and for DC to DC converter circuits are known. And for example, a laminating mold inductor accumulates two or more ceramic green sheets which consist of a magnetic-substance ingredient (ferrite) or an insulator ingredient, calcinates them in one, and constitutes the layered product. The coil which connected and constituted electrically two or more conductor patterns for coils in the serial through the beer hall is prepared in the interior of this layered product. Thus, since the high insulating

ceramic green sheet is being used for the conventional laminating mold inductor, it can form the conductor pattern for coils, and a beer hall in a ceramic green sheet as it is, and has the advantage that processing is easy.

[0003]

[Problem(s) to be Solved by the Invention] However, in order to make the ceramics calcinate, it is necessary to process at the temperature of about 900 degrees C. Therefore, the hot firing furnace was needed and it had become the cause which makes the manufacturing cost of the conventional laminating mold inductor raise also including the high running cost. Moreover, the internal residual stress of a laminating mold inductor was also comparatively large because of processing of high temperature. On the other hand, the ceramics and oxide magnetic materials, such as a ferrite, have a problem in magnetic properties, the permeability of a general NiZn system ferrite is about 2000, and there is only about 5000 gauss saturation magnetic flux density. Therefore, the laminating mold inductor using this oxide magnetic material had the low limitation of an electrical property, and was difficult to miniaturize.

[0004] On the other hand, the metal magnetic material is excellent in magnetic properties, and has the features that especially saturation magnetic flux density is high. However, its specific resistance was small, and since a metal magnetic material was able to form neither the conductor pattern for coils, nor a beer hall directly, it was difficult [to apply] for the electronic parts of a laminated structure conventionally. Furthermore, since it would oxidize if a metal magnetic material is exposed to an elevated temperature like [at the time of ceramic baking], and a property fell, it had been to bases to process it at the low temperature of soldering temperature (about 300 degrees C). Therefore, it was conventionally used as an object for coil coils which carries out low temperature treatment.

[0005] Then, the object of this invention is offering-by low cost using metal magnetic material-small laminating mold metal magnetism electronic-parts and its manufacture approach ****.

[0006]

[Means for Solving the Problem and its Function] In order to attain said object, the laminating mold metal magnetism electronic parts concerning this invention (a) The resin layer formed in each front face of two or more metal magnetism plates and the metal magnetism plate of (b) plurality, (c) in order to connect electrically two or more conductor patterns for coils prepared in the front face of two or more metal

magnetism plates through the resin layer, and the conductor pattern for coils of (d) plurality It has the beer hall which comes to fill [electric conduction material] up the hole for beer halls prepared in the metal magnetism plate. (e) It is characterized by accumulating two or more metal magnetism plates, and preparing the coil which connected and constituted electrically two or more conductor patterns for coils in the serial through the beer hall at the layered product which was pasted up and constituted from a resin layer, and covering the internal surface of the hole for beer halls by the insulator layer.

[0007] As for the shaft orientations of a coil, it is desirable to lie at right angles to the direction of a pile of a metal magnetism plate here. Furthermore, it is desirable to have extended on the top face or/and underside of a layered product so that the external terminal electrode of the top face of a layered product and an underside prepared in the end face of a layered product while the terminal section of a coil was drawn by one of fields at least may connect with the terminal section of a coil electrically.

[0008] Moreover, the manufacture approach of the laminating mold metal magnetism electronic parts concerning this invention (f) While forming the hole for beer halls in the process which forms a resin layer in the front face of a metal magnetism plate, and (g) metal magnetism plate The process which fills up electric conduction material with an insulator layer into a wrap process and the hole for (h) beer halls for the internal surface of the hole for beer halls, and forms a beer hall, (i) While accumulating the process which forms the conductor pattern for coils in the front face of a metal magnetism plate through a resin layer, and (j) metal magnetism plate, pasting up in a resin layer and forming a layered product It is characterized by having the process which connects the conductor pattern for coils to a serial electrically through a beer hall, and constitutes a coil.

[0009] Or the manufacture approach of the laminating mold metal magnetism electronic parts concerning this invention (k) While forming the hole for beer halls in the process which forms a resin layer in the front face of a metal magnetism plate, and (l) metal magnetism plate While accumulating a wrap process and (m) metal magnetism plate by the insulator layer, pasting up the internal surface of the hole for beer halls in a resin layer and forming a composite object The process which connects the hole for beer halls in the direction of a pile, and the process which fills up with electric conduction material the hole for beer halls by which (n) connection was carried out, and forms a long picture-like beer hall, (o) While arranging the metal magnetism plate of

a composite object which formed the conductor pattern for coils in the front face through the resin layer up and down It is characterized by having the process which connects the conductor pattern for coils to a long picture-like beer hall electrically through the beer hall formed in this metal magnetism plate, and constitutes a coil.
[0010] It pastes up in a resin layer and the accumulated metal magnetism plates are made a layered product by the above configuration. The conductor pattern for coils does not need to contact a metal magnetism plate and directly by the resin layer. A beer hall does not need to contact a metal magnetism plate and directly by the insulator layer which has covered the internal surface of the hole for beer halls.
[0011] And property degradation of a metal magnetism plate can be prevented using heat-curing mold conductive paste processible into the electric conduction material with which the conductor pattern for coils and the hole for beer halls are filled up on temperature conditions 300 degrees C or less, or the conductive paste which can carry out low-temperature baking by being made to perform processing in all processes on temperature conditions 300 degrees C or less.
[0012]
[Embodiment of the Invention] Hereafter, the gestalt of operation of the laminating mold metal magnetism electronic parts concerning this invention and its manufacture approach is explained with reference to an attached drawing.
[0013] The 1st operation gestalt of [the 1st operation gestalt, drawing 1 - drawing 11] makes a laminating mold inductor an example, and explains it. As shown in drawing 1 , the sheet metal 1 which uses a metal magnetic material as a principal component is prepared, and the resin layer 2 is formed in the front face. In order that the thickness of metal magnetism sheet metal 1 might lessen eddy current loss, the thinnest possible thing was good and the silicon steel whose thickness is about 50 micrometers was used with the **** 1 operation gestalt.
[0014] As an ingredient of the resin layer 2, the thermosetting resin (for example, epoxy, polyimide) which can carry out temporary hardening, thermoplastics (for example, polyphenylene sulfide, a polyether ether ketone, polyethylene terephthalate, polyphenylene OKISAITO) with heat welding nature, etc. are used. As an approach of forming the resin layer 2, screen printing, a spray atomizing process, a dipping method, a doctor blade method, or the approach of pasting up a resin sheet is used. The **** 1 operation gestalt formed in the front face (or front flesh-side both sides) of metal magnetism sheet metal 1 the epoxy resin layer 2 whose thickness is about 20 micrometers with screen printing, and it

was made it to carry out temporary hardening in optimal temperature so that the resin layer 2 which has thickness with an evenly uniform front face can be obtained.

[0015] Next, as shown in drawing 2 , the holes 3a-3f for beer halls are formed in the predetermined location of metal magnetism sheet metal 1. Carbon-dioxide-gas laser beam machining is performed, the spot exposure of the laser beam LB is carried out, it decomposed and metal magnetism sheet metal 1 and the resin layer 2 were made burned down by the **** 1 operation gestalt at an elevated temperature. At this time, an oxide film (insulator layer) is formed in a holes [of metal magnetism sheet metal 1 / for beer halls / 3a-3f] internal surface of an elevated temperature. In addition, although the holes 3a-3f for beer halls are cross-section round shapes, you may be an ellipse form, a rectangle, etc.

[0016] Next, as shown in drawing 3 , two or more metal magnetism sheet metal 1 with which the holes 3a-3f for beer halls were formed is prepared, and is accumulated. The resin layer 2 is turned up and it is made for the holes 3a-3f for beer halls of each metal magnetism sheet metal 1 to be connected in the direction of a pile at this time. Then, it pressurizes heating and both metal magnetism sheet metal 1 is pasted up in the resin layer 2 fused temporarily. In this way, the composite object 4 is acquired.

[0017] Next, the holes 3a-3f for beer halls of the composite object 4 are filled up with a conductive paste. That is, as shown in drawing 4 , the composite object 4 is laid in the upper part at the cavity 30 with opening 30a. The masking material 31 in which hole 31a corresponding to the holes 3a-3f for beer halls was formed is put on the top face of the composite object 4. Then, the holes 3a-3f for beer halls are made to fill up with the conductive paste 32 by ******(ing) the conductive paste 32 by the squeegee 33, attracting the air in a cavity 30. The thing of the heat-curing mold with which the conductive paste 32 added thermosetting resin to low resistance electrical conducting materials, such as silver of a principal component or copper, and the thing of a low-temperature-sintering mold are used. The conductive paste 32 with which it filled up is made into dryness, a hardening condition, or a sintering condition. In this way, the long picture-like beer halls 33a-33f (refer to drawing 5) are formed.

[0018] In addition, the **** 1 operation gestalt forms the thick film conductor in the top face of the composite object 4 using the masking material 31. However, as long as it is not necessary to form a thick film conductor, you may be the screen printing which used the screen version. Moreover, there is also the approach of immersing for it and

carrying out vacuum degassing of the composite object 4 to a conductive paste bath as an approach of filling up the holes 3a-3f for beer halls with a conductive paste. however, this approach -- a conductive paste -- the object for beer halls -- since it adheres not only to the inside of hole 3a - 3f but to the front face of the composite object 4, the activity cutting off the conductive paste adhering to a front face is needed.

[0019] Next, as shown in drawing 5 , the metal magnetism sheet metal 1 which formed the conductor patterns 5, 7, 9, and 11 for coils on the composite object 4 on the top face is arranged. This metal magnetism sheet metal 1 fills up the holes 3a-3f for beer halls with a conductive paste, and forms beer halls 33a-33f while it is the same as that of what was shown in drawing 2 and forms the conductor patterns 5, 7, 9, and 11 for coils in the front face of the resin layer 2 with screen printing etc.

[0020] Moreover, the metal magnetism sheet metal 1 which formed the conductor patterns 6, 8, and 10 for coils in the bottom of the composite object 4 on the underside is arranged. This metal magnetism sheet metal 1 is the same as that of the thing in which the resin layer 2 was formed to vertical both sides, in what was shown in drawing 2 . And while forming the conductor patterns 6, 8, and 10 for coils with screen printing etc., the holes 3a-3f for beer halls are filled up with a conductive paste, and beer halls 33a-33f are formed in the front face of the resin layer 2 formed in the underside. Here, the conductive paste used for formation of the conductor patterns 5-11 for coils and beer halls 33a-33f can be processed at the temperature which the resin layer 2 does not dissolve, i.e., temperature with low extent in which the resin layer 2 does not lose an adhesion function, (300 degrees C or less).

[0021] The conductor patterns 6, 8, and 10 for coils of the lower berth are arranged in the same layer at the conductor patterns 5, 7, and 9 for coils of an upper case, and 11 lists, respectively. It connects with the coil conductor patterns 6, 8, and 10 electrically one by one at a serial through the beer halls 33d, 33a, 33e, 33b, 33f, and 33c arranged at the same layer, respectively, and the conductor patterns 5, 7, 9, and 11 for coils constitute the spiral coil L. The shaft orientations of the spiral coil L are vertical to the vertical and below-mentioned I/O external electrodes 20 and 21 to the direction of a pile of metal magnetism sheet metal 1. In other words, the shaft orientations of the spiral coil L are parallel to the component side of the laminating mold inductor 25.

[0022] Then, the composite object 4 and the metal magnetism sheet metal

1 arranged up and down are pressurized heating, and is pasted up in one in the resin layer 2, and it considers as the layered product 12 of the shape of a rectangle object as shown in drawing 6 .

[0023] Next, masking material is used, carry out mask printing of the heat-curing mold resin of high thermal resistance, the vertical side of a layered product 12 is made to carry out heat curing in optimal temperature, and protective layers 13 and 14 are formed in it. The protective layer 13 left some conductor patterns 5 and 11 for coils exposed from Openings 13a and 13b, and has covered the conductor patterns 5, 7, 9, and 11 for coils. Similarly, the protective layer 14 has covered the conductor patterns 6, 8, and 10 for coils.

[0024] Moreover, since the edge of metal magnetism sheet metal 1 is exposed to the side face of a layered product 12, as it is immersed in the heat-curing mold resin bath of high thermal resistance, and heat curing of the lateral portion is carried out in optimal temperature and it is shown in drawing 7 , the pre-insulation film 15 is formed. In addition, a layered product 12 may be heated at an elevated temperature, the front face of the edge of the metal magnetism sheet metal 1 exposed to a side face may be oxidized, and an oxide coat may be made to form.

[0025] Next, as shown in drawing 8 , it is immersed in a heat-curing mold conductivity paste bath or a low-temperature-sintering mold conductivity paste bath, the right-and-left both ends of a layered product 12 are made to harden or sinter in optimal temperature, and the substrate electrode of an external terminal electrode is formed. It galvanizes on the front face of this substrate electrode, and the external terminal electrodes 20 and 21 are formed. The external terminal electrodes 20 and 21 were formed in the end face of right and left of a layered product 12, respectively, and they have extended on the top face of a layered product 12 so that it may connect with the terminal section (namely, conductor patterns 5 and 11 for coils) of the spiral coil L electrically. In this way, the laminating mold inductor 25 is obtained. Drawing 9 is type section drawing of the laminating mold inductor 25.

[0026] Since the laminating mold inductor 25 which consists of the above configuration forms the layered product 12 using metal magnetism sheet metal 1, as compared with the case where a layered product is formed using the conventional ceramic green sheet, the deformation at the time of processing cannot break out easily, and the layered product 12 with sufficient process tolerance is obtained. And even if a mechanical strength is high as compared with a ceramic ingredient and the thickness of a layered product 12 is thin, it is hard to damage a metal magnetic material.

[0027] Moreover, since the laminating of the metal magnetism sheet metal 1 is carried out through the resin layer 2, generating of an eddy current is mitigable. Furthermore, the magnetic flux produced with the spiral coil L passes along the inside of metal magnetism sheet metal 1 in parallel at a principal plane, and since the protective layers 13 and 14 which cover the conductor patterns 5-11 for coils of sheet metal 1 consist of resin of a non-magnetic material, they do not generate an eddy current into this part, but can obtain the laminating mold inductor 25 with more little loss into it. Drawing 10 and drawing 11 are graphs which show a direct-current superposition property to the frequency-characteristics list of the laminating mold inductor 25, respectively (continuous-line 40 reference). In addition, the direct-current superposition property is also collectively indicated at drawing 10 and drawing 11 in the frequency-characteristics list of the laminating mold inductor manufactured using the ceramic green sheet which consists of the conventional ferrite (dotted-line 41 reference). Although an inductance value falls early in a RF region as compared with the conventional inductor, the direct-current superposition property is excellent in the laminating mold inductor 25. Furthermore, since the internal residual stress of the saturation magnetic flux density of silicon steel which poses a problem by those of a ferrite with about 4 times and the conventional inductor is also small, the outstanding property is acquired.

[0028] Furthermore, since the ingredient which can be processed at low temperature (300 degrees C or less) is used as the conductive ingredient of the conductor patterns 5-11 for coils, beer halls 33a-33f, and the external terminal electrodes 20 and 21, and an insulating ingredient of the resin layer 2, all down stream processing can be performed under temperature conditions 300 degrees C or less. Therefore, property degradation of metal magnetism sheet metal 1 can be prevented.

[0029] The 2nd operation gestalt of [the 2nd operation gestalt and drawing 12] makes an example the case where the laminating mold inductor 25 of said 1st operation gestalt is mass-produced using a mother substrate, and explains.

[0030] Metal magnetism mother sheet metal 1A of the extensive area which can take two or more laminating mold inductors 25 is prepared, and the array location of an inductor 25 is determined in all directions. According to this location, the holes 3a-3f for beer halls are formed in the resin layer 2A list for several array minutes, further, a conductive paste is filled up with the same approach as the 1st operation gestalt into the holes 3a-3f for beer halls, and beer halls 33a-33f are formed

by it. At this time, the conductor patterns 5-11 for coils are also formed in predetermined metal magnetism mother sheet metal 1A.
[0031] Next, as shown in drawing 12 , a required-number pile and its metal magnetism mother sheet metal 1A which formed the conductor patterns 5-11 for coils up and down are arranged for metal magnetism mother sheet metal 1A which formed only the beer halls 33a-33f processed in this way, and the mother sheets 13A and 14A for protection are further arranged on the outside. Then, it pressurizes heating the whole, metal magnetism mother substrate 1A is pasted up in one in resin layer 2A, and a mother layered product is formed. In addition, in drawing 12 , the conductor patterns 5-11 for coils and beer halls 33a-33f which were formed in metal magnetism mother sheet metal 1A are omitted.
[0032] Next, this mother layered product is cut in all directions with a dicer, a laser beam, or a jet stream, it starts for every size enclosed with the alternate long and short dash line of drawing 12 , and a layered product 12 is obtained. When a mother layered product is cut by the dicer or the laser beam at this time, the front face of the edge of metal magnetism sheet metal 1A exposed to the cutting plane of a layered product 12 oxidizes and insulation-izes by the high temperature produced in the case of cutting. Therefore, it is not necessary to carry out insulating processing to the side face of a layered product 12. Then, it prepares in the end face of right and left of the external terminal electrodes 20 and 21 of a layered product 12 by the same approach as the 1st operation gestalt, and considers as a finished product.
[0033] Thus, since the **** 2 operation gestalt is using metal magnetism mother sheet metal 1A, it can be produced to a large quantity by once, and can obtain the laminating mold inductor 25 well by low cost. In addition, also when forming a layered product using a ceramic green sheet, it can take, if the green sheet of extensive area is used, and the number can increase, and it can respond to mass production. However, in this case, with a green sheet, the contraction at the time of processing and elongation are large, and much more improvement in process tolerance is called for. On the other hand, in metal magnetism mother sheet metal 1A, neither the contraction at the time of processing nor elongation can occur easily, and the picking number can be increased comparatively easily.
[0034] operation gestalt] besides [-- in addition, this invention is not limited to said operation gestalt, within the limits of the summary, can be boiled variously and can be changed. For example, this invention is applicable also to the compound electronic parts containing a choke coil, or the transformer or coil other than an inductor. Furthermore,

electropainting of resin etc. may be adopted as the approach of insulation-izing of a holes [of metal magnetism sheet metal 1 / for beer halls / 3a-3f] internal surface.

[0035]

[Effect of the Invention] Since the layered product is formed using a metal magnetism plate according to this invention so that clearly from the above explanation, as compared with the case where a layered product is formed using the conventional ceramic green sheet, the deformation at the time of processing cannot break out easily, and a layered product with sufficient process tolerance can be obtained. And even if a mechanical strength is high as compared with a ceramic ingredient and the thickness of a layered product is thin, it is hard to damage a metal magnetic material.

[0036] Moreover, since the laminating of the metal magnetism plate is carried out through the resin layer, generating of an eddy current is mitigable. Furthermore, by making the shaft orientations of a coil vertical to the direction of a pile of a metal magnetism plate, the magnetic flux produced with a coil can pass along the inside of a metal magnetism plate in parallel at a principal plane, and can suppress generating of an eddy current further.

[0037] Moreover, property degradation of a metal magnetism plate can be prevented by performing processing in all processes on temperature conditions 300 degrees C or less.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The perspective view showing an example of the manufacture approach of the laminating mold metal magnetism electronic parts

concerning this invention.
[Drawing 2] The perspective view showing the production process following drawing 1 .
[Drawing 3] The perspective view showing the production process following drawing 2 .
[Drawing 4] The sectional view showing the production process following drawing 3 .
[Drawing 5] The perspective view showing the production process following drawing 4 .
[Drawing 6] The perspective view showing the production process following drawing 5 .
[Drawing 7] The perspective view showing the production process following drawing 6 .
[Drawing 8] The perspective view showing the production process following drawing 7 .
[Drawing 9] Type section drawing of the laminating mold metal magnetism electronic parts shown in drawing 8 .
[Drawing 10] The graph which shows the frequency characteristics of the laminating mold metal magnetism electronic parts shown in drawing 8 .
[Drawing 11] The graph which shows the direct-current superposition property of the laminating mold metal magnetism electronic parts shown in drawing 8 .
[Drawing 12] The decomposition perspective view showing another example of the manufacture approach of the laminating mold metal magnetism electronic parts concerning this invention.
[Description of Notations]
1 -- Metal magnetism sheet metal
1A -- Metal magnetism mother sheet metal
2 2A -- Resin layer
3a-3f -- Hole for beer halls
4 -- Composite object
5-11 -- Conductor pattern for coils
12 -- Layered product
20 21 -- External terminal electrode
25 -- Laminating mold inductor
32 -- Conductive paste
33a-33f -- Beer hall
L -- Spiral coil

[Translation done.]

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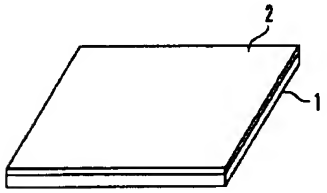
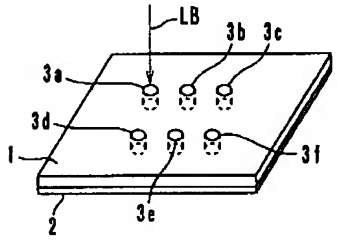
DRAWINGS

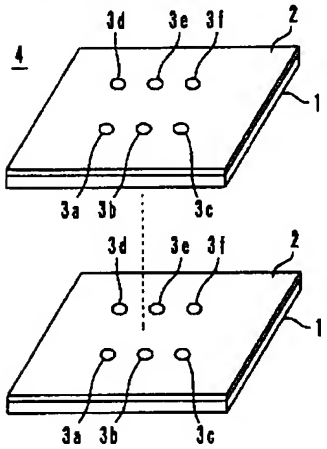
[Drawing 1]



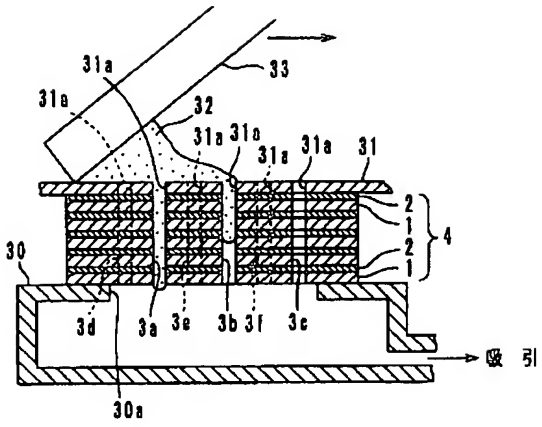
[Drawing 2]



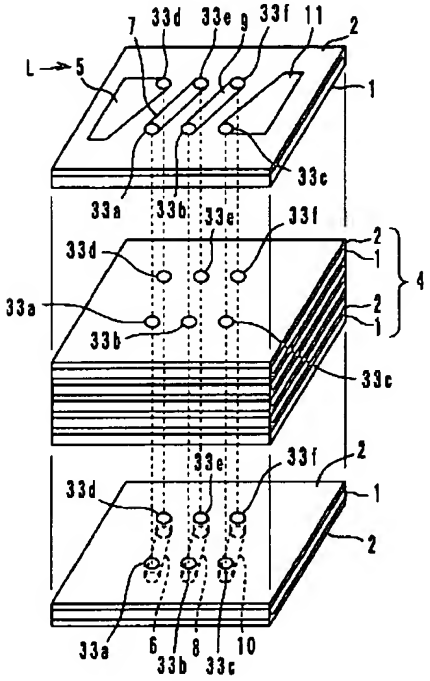
[Drawing 3]



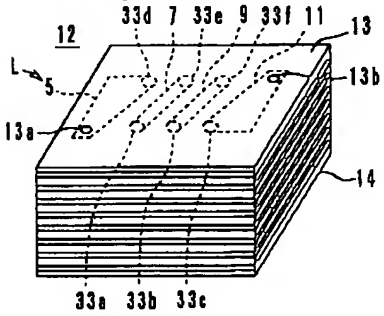
[Drawing 4]



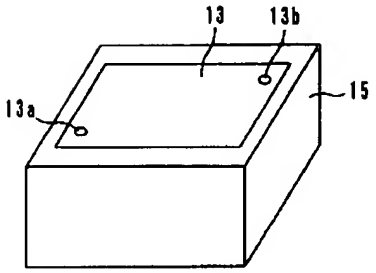
[Drawing 5]



[Drawing 6]



[Drawing 7]



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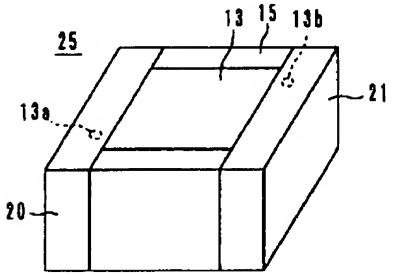

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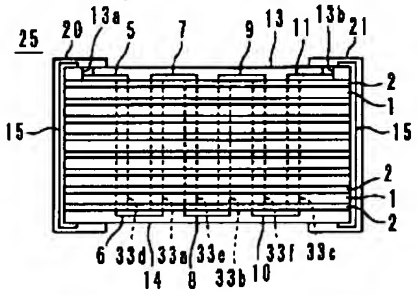
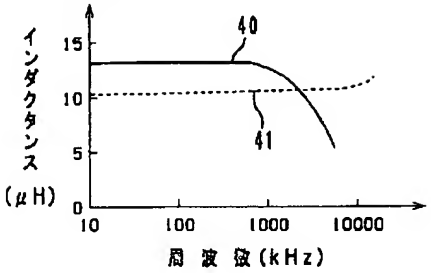
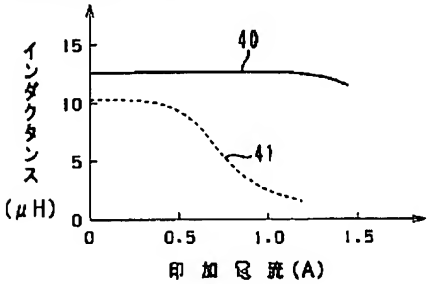


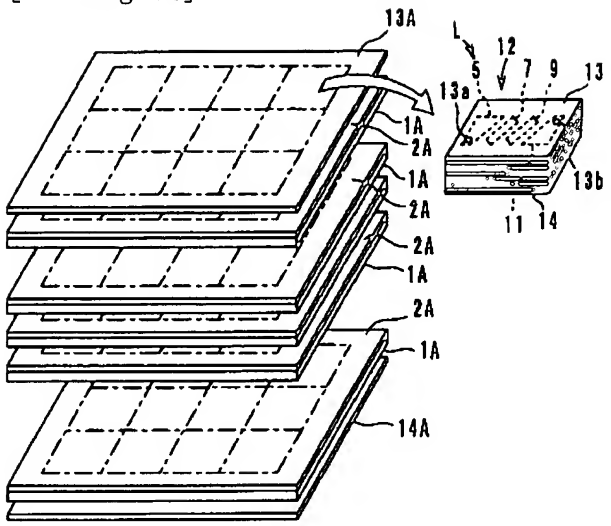
[Drawing 10]



[Drawing 11]



[Drawing 12]



[Translation done.]